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# RIT

## **Healthway: A Personal Health Record System for User to Manage Their Own Health Condition**

BY

**Jie Zhang**

A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Fine Arts in Visual  
Communication Design

School of Design  
College of Art and Design  
Rochester Institute of Technology  
Rochester, NY  
March 30, 2021

## Committee Approval

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## Abstract

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The 21st century is the era of the Internet, big data, but also the era of AI. The vigorous development of AI and Internet technology has also injected fresh blood into the traditional medical industry. Today, the Internet affects every aspect of the medical and health industry. For example, medical providers can use the Electronic Health Record System (EHR) to quickly obtain the necessary information and data to assist them to make disease diagnoses. The remote consultation and consultation of medical staff also require the help of the Internet, especially the 5G Internet. In this context, the demands of individual users for health services have gradually expanded to the network, and the demands for fast access to health data, remote consultation, and medical appointments have also gradually become prominent. Especially during COVID-19, due to the city's restrictions command and social distance rule, the advantages of online medical services have also been reflected. Under this situation, as the designer, I began to think about the impact of design on the medical industry.

The project Healthway reflects the outlook and vision of the future medical industry. With the development of medical testing technology, a large amount of data content is continuously obtained. At present, many hospitals generally use the traditional record and storage method of handwritten or paper documents, its limitations gradually appear. Therefore, the demand for medical data analysis and visualization based on the Internet platform has gradually become one of the critical needs of the medical industry. Healthway is attempting to provide users with a wealth of health data that will allow patients to actively participate in the management of their health.

## Keywords

Healthcare, Electronic Health Record System(EHR), Personal Health Record System(PHR), Data Dashboard, Data Visualization, O2O, Online Medical Consultation, Gout

## Introduction

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With the increasing popularity of IoT applications, smartphones have gradually become the hub of computing devices that integrate entertainment and information. Now the screen of our smartphone is becoming larger. The reason behind this transition is because mobile phones carry more and more information. The information of medical data on a smartphone application in at an early stage, there is enough potential can be discovered, so hope that through this topic "personal medical information system design" for the application of IoT medical to make a breakthrough. Such as the points talked in the abstract part, features like health data records, remote consultation, and medical appointments are critical for many users to access healthcare services.

In the 21st century, rapid informatization makes the management of medical enterprises more efficient, and the popularity rate of Electronic Health Records (EHR) system in the medical industry has been increasing soon. But even so, the information barrier has not been eliminated, and there is a considerable lag between the information that users could access and the hospital.

After research, I got three challenges that Healthway needs to solve. (1) The first one is the difficulty and inconvenience for patients to collect health data. (2) The second problem is the information lag, which makes people difficult to understand their health condition. (3) The last one is the tedious appointment process for patients to meet their doctor.

Considering those challenges, Healthway aims to create a Personal Health Records (PHR) platform for users to view and manage their health, so everyone's health can be "monitored" in a timely and effective way. Also, Healthway makes the health information available to their physicians through data sharing as well. Once the user's indicators are abnormal, the system will give feedback to the user and remind their doctor in time and provide further follow-up services to the user. At this time, offline healthcare resources can be quickly connected to achieve a closed-loop in business.

As for the target users, Healthway focuses on patients with chronic diseases. Due to the long course of chronic diseases, patients with chronic diseases, compared with other patients, often need long-term statistical tracking of relevant health indicators. Empowering rehabilitation management for patients with chronic diseases is Healthway's vision.

This thesis hopes to explore the feasible prospect of the future medical industry based on the current application of high and new technology in the medical industry. Build a product from zero to one through a user experience design approach. This article will focus on how Healthway helps users collect health data and how the data is presented. And how to carry out the follow-up service process of abnormal data. Besides, there is a realistic situation that is the key consideration in the design, is the protection of user privacy. Once applied to the business, privacy protection will become a consideration for users. Moreover, this article aims to explore innovative interactions between IoT devices and smartphones, to build a more complete medical service system.

Finally, we hope that the design of Healthway can bring some inspiration for the development of human health in the future. As the designer and product owner of this project, I believe the design could drive technology forward, including personal IoT medical devices and AI doctors.

## Context

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Health is a concern of all human beings, both medical personnel and the general public. Medical treatment has always played an important role in the development of people's livelihood in all countries. It is also an area that governments of all countries strive to improve, to improve the standard of medical treatment for the whole people and the popularization of various systems. But even in the 21st century, with the rapid development of modern healthcare, humans are still suffering from chronic and infectious diseases of all kinds. Even for patients infected with the same disease, due to the existence of individual differences, medical treatment should not only be based on the universal cases but also need to meet the individual patient's physical signs.

The COVID-19 virus, which continued in late 2019, has had a significant impact on people's lives around the world. As the first global pandemic virus encountered by humans during the rapid development of the mobile Internet, the mobile care network played a vital role. Users can quickly view the infection situation nearby, make an appointment with nucleic acid testing institutions, make an appointment with vaccines, etc. China has also designed a passing code to detect whether the person has been in or out of high-risk areas. Under the influence of COVID-19, both the government and the public have raised higher expectations for the development of the health industry.

Healthway selected gout patients as the main user group for the design. Firstly, we will introduce gout, which is a common disease in many countries in the world. The number of hyperuricemia patients in China has reached 170 million, including more than 80 million gout patients, which is rapidly increasing at an annual growth rate of 9.7%. The number of gout sufferers is expected to reach 100 million by 2020. Now gout has become the second-largest metabolic disease in China, second only to diabetes, and it is a health warning that can not be ignored. In the US, Gout was found to be more common in men than in women. The condition now affects about 8.3 million people or 4% of the population. And the risk of getting gout increases with age.

For the healthcare industry, IoT technology allows people to put their health in their pockets. All personal health data can be visualized in a complete database through the exchange of data between a small home monitoring device and a smartphone. Cloud data storage can solve the storage capacity limitation of testing devices, and realize the rapid data exchange between patients and doctors, to achieve more accurate and personalized medical services.

# Evolution

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## Methodology

### Phase 1: Interview

The interviews were divided into two rounds, which were patient interviews and expert interviews. Finally, the design objectives were derived from the conclusions of the interviews.

In the part of the patient interview, I interviewed 4 to 5 patients around me who were affected by gout disease. The interview mainly focused on the daily life, disease treatment, and rehabilitation of gout patients. The main appeal of the user population is the need for regular uric acid testing to timely understand the range of changes in uric acid content.

In the expert interview stage, I looked for doctoral students majoring in statistics from Harvard University and Peking University. The conclusion is as follows: The accuracy and efficiency of diagnosis have been significantly improved by health records. For scientific research institutions can also provide enough research data and samples; However, in terms of the collection method, patients' records still need to be filed offline in hospitals. At the same time, there is no data exchange between hospitals, and some doctors still use handwritten medical records, resulting in the absence of files.

### Phase 2: Content Analysis

In this part, I focus on IoT technology, PHR system, and data indicators related to gout disease. Finally, I got a conclusion about how to build a PHR system which could give me a suggestion on how to design the workflow.

As for the research on IoT devices, I refer to the interactive experience of iOS Home and Apple Watch. In iOS Home, the user can complete the pairing by purchasing the supported third-party device, opening the camera, and scanning it. Finally, the user needs to relay the data through the WiFi network. The Apple Watch sends data to the phone over the phone's cellular network.

PHR system is a new type of Internet technology in the application of health information records. PHR system can collect patients' health data, carry relevant medical knowledge and information, as well as access to related tools and software in the medical field. Using this system, users can play an active role in their health management. The PHR system can be integrated with a hospital's electronic health data system and, once integrated with an EHR system, can provide even greater benefits than stand-alone systems.

### Phase 3: Participant Observation

Based on my own experience in medical treatment, I analyzed and summarized doctor-patient touchpoints in the process of medical treatment, among which there are 3 important touchpoints. The first one is an appointment, the second one is the synchronization of medical treatment results, and the third one is an inquiry of professional disease knowledge. I build empathy with users through my own experiences.

#### Phase 4: User-centered design thinking

In the design process, using the user-centered design thinking, which can be divided into several sections, namely user research, definition, design, user testing, iteration. In the user research section, user research is conducted on relevant industries, technologies, and user behavior patterns, and then the original product's requirements are obtained. In the Definition section, the product model and architecture are derived from the original requirements. In the design phase, the wireframe and the main interaction flow are produced. In the user testing part, the existing prototype drawings will be tested and the feedback from target users will be collected. In the final iteration, details will be optimized to meet the demands of target users to the greatest extent.

#### **Design Goals:**

As a result of the research, Healthway identified four specific design goals that were used to frame and prototype the entire product.

1. Personal health record system

Healthway, as mentioned above, wants to build a better PHR system. To help users manage their health by collecting their health data. And the data exchange with the hospital EHR system, to provide patients with more targeted personalized medical services.

2. Intelligent connectivity using home IoT medical devices

The application of IoT technology can make data collection more convenient. Traditional medical records, which rely on manual input and records, are inefficient. Healthway's third goal is to reduce the user's workload in recording and typing and also greatly improve the amount of data that can be presented.

3. Achieve timely feedback for abnormal data

The hospital has established a set of rapid medical testing mechanisms. Once the patient's data indicators are abnormal, the test sheet will record and mark the fluctuating data, so that patients and doctors can easily see the abnormal situation of the indicators. Therefore, special design considerations have been taken into account in the presentation of abnormal data in Healthway. When the device detects abnormal data, it generates an abnormal data report card and immediately notifies the user in the form of a notification. Behind the scenes, the AI system also provides suggestions and directions based on the disease model.

4. O2O medical service and data synchronization

Healthway facilitates the communication between patients and doctors, and when it comes to online health services, it also ensures that they can be extended offline, making it seamless.



### Three Main User Scenarios and Workflows:

The final part of the design is presented, focusing on the presentation of three main user operation scenarios. The interactive introduction of the three scenarios and the corresponding interactive process are shown below

#### 1. Connect IoT devices and view the data (Figure 1)

The user can connect their IoT devices to collect the data, then all of the data can be synced to their mobile phone. The user can browse the changes of the data over time.

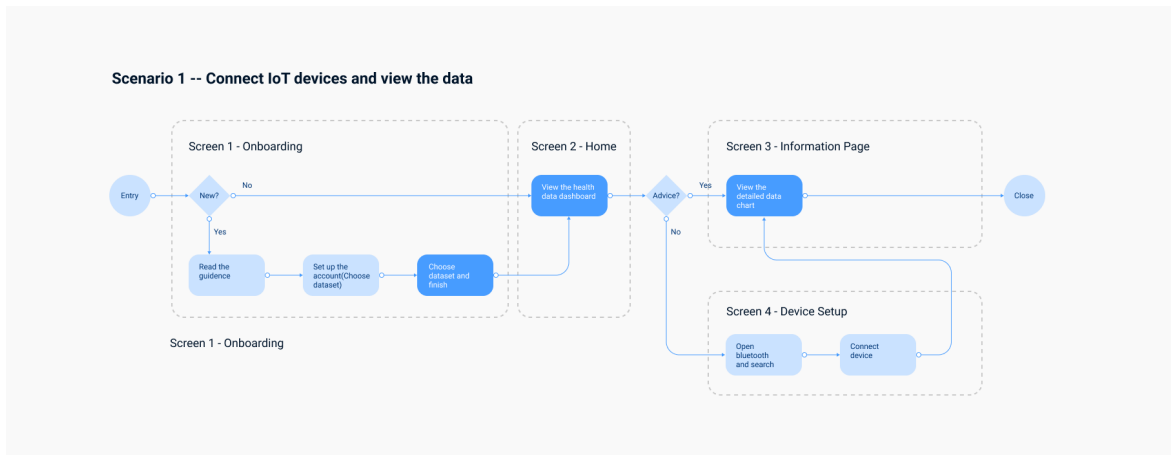


Figure 1

#### 2. Receive timely health reminders and schedule a doctor (Figure 2)

When the data became abnormal, the system will analyze it, then reminds users the abnormal data and give them suggestion made by AI.

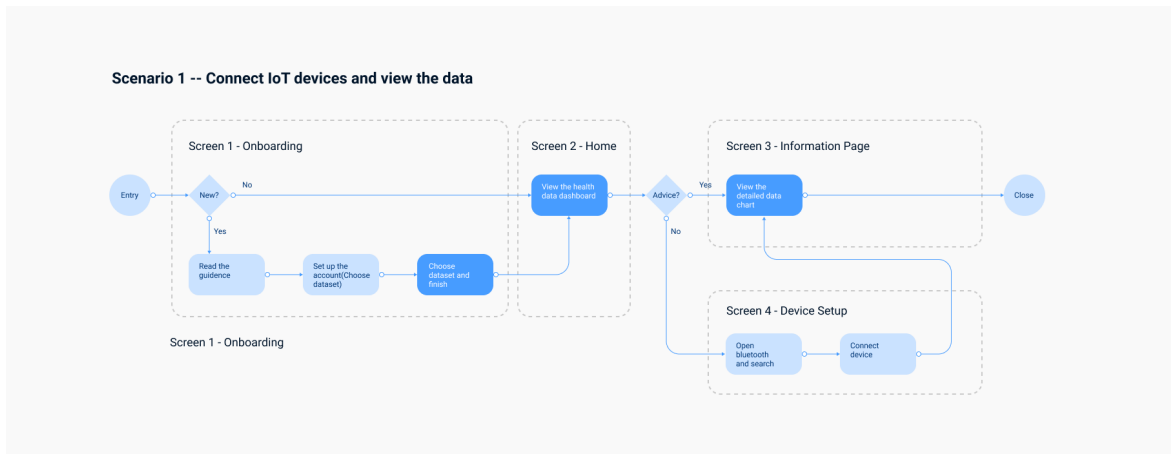


Figure 2

### 3. Contact online, enjoy medical services offline

The user can share the data with their doctors, the doctor can monitor the change of data anytime. With the help of HealthWay, the doctor can connect with the patients as soon as possible.

## Wireframes

Based on the three main usage scenarios, the corresponding interface is designed, in which the interaction process is designed for the user operations that are mainly presented. Based on the interaction wireframe, the output of the UI visual wireframe is finally completed. In the end, more than 15 screens were designed, and the state changes of the key screens were also designed after user interaction.

The first problem I solved in my work is the difficulty and inconvenience for patients to collect health data. The device module in Healthway provides an IoT device management center. The user can add a new device or manage all connected devices. (Figure 3.1)

The second problem the patients encountered in their life is difficult to detect all the health data timely, so it causes information lag. Healthway's dashboard displays every data the gout patient needs to know, it will update soon once the system receives the data from the IoT device. There are three different states show different health condition, to make the data more readable and understandable. (Figure 3.2)

The third problem in my work is to simplify the tedious appointment process. When the data got worse, the system will suggest the user schedule a doctor for a further check-up in the hospital. Healthway also provides an instant messaging system(IM system) which helps them contact doctors online, in addition, the results also can be transferred to the patient using the IM system. (Figure 3.3)

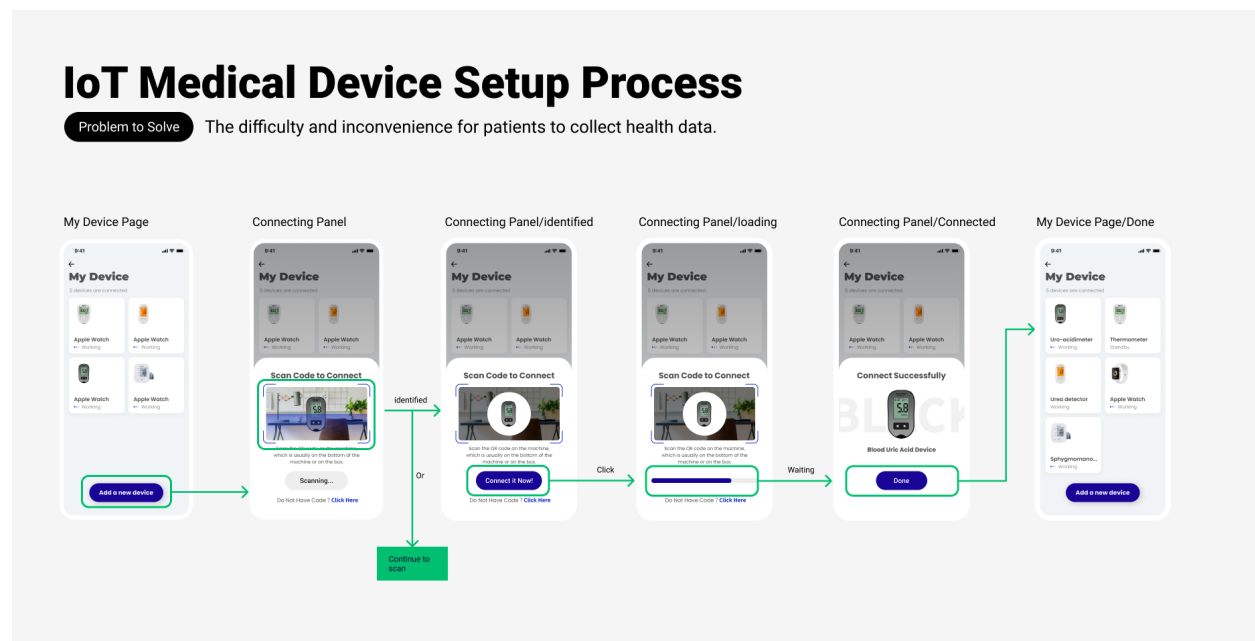


Figure 3.1

# Data Dashboard

**Problem to Solve** The information lag and inconcentration, which makes people difficult to understand their health condition.

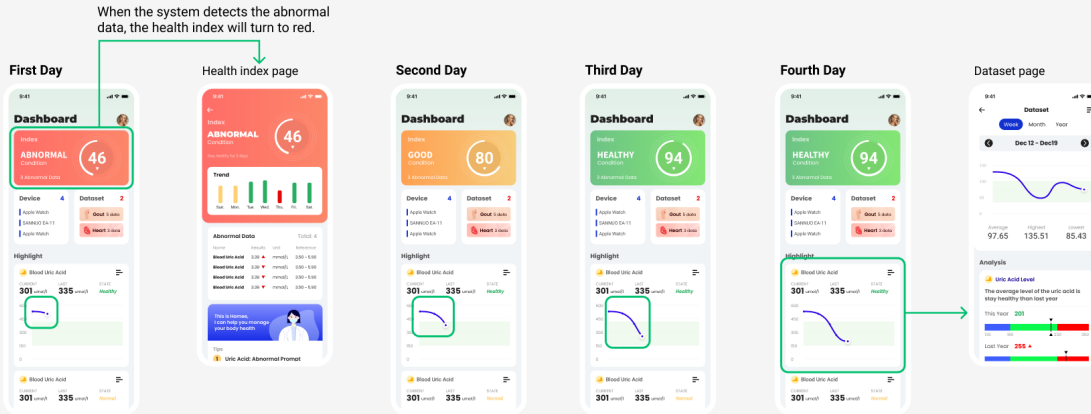


Figure 3.2

# Medical Service Schedule Process

**Problem to Solve** The tedious appointment process

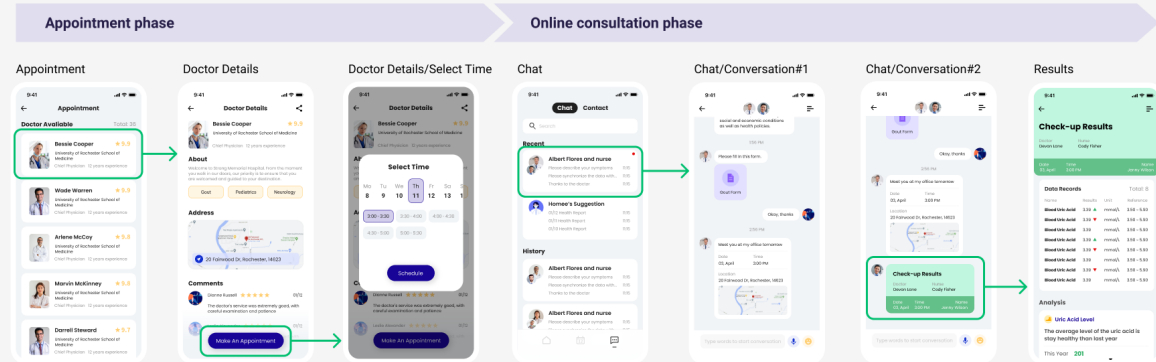


Figure 3.3

## Body of Work

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### Screen 1: Onboarding

In Onboarding, the user needs to set the type of disease they are interested in so that the system can match the user to the appropriate database.

### Screen 2: Home

On the Home page(Figure4-A), the user will see their health data dashboard, which will contain the following fields of information: health index, IoT device, database, and data chart card.

### Screen 3: Home/device connection

The device connection page(Figure4-B) is used to configure IoT devices. The entry is located at the Device card in the middle of the home page. Click to enter the interface. In this interface, the IoT device that has been set up will be present and the current working status can be viewed. Besides, click the button to add a new device.

### Screen 4: Home / Health Index

The health index page(Figure4-C) is used to present the health value of the system statistics, which is strongly correlated with the relevant health data. The interface also contains three different states, corresponding to health, normal, abnormal, each state has a different color, and the interface below the historical record and other information.

### Screen 5: Home / Health Index / Appointment

The entry of the appointment page(Figure5-A)is in the health index. Once there is abnormal data was detected by the system, the page will actualize the relevant operation of the appointment and remind the user to carry out the follow-up examination process at the local hospital.

### Screen 6: Home / Detailed data information

On the data page(Figure5-B), the user can view the specific statistical results of data, including the change curve of recent data.

### Screen 7: Contact

The contact page(Figure5-C) helps patients to chat with the doctor directly online. Healthway has access to Internet-based healthcare resources, and when an appointment is made, it automatically creates a private group of doctors, nurses, and patients for users to communicate with online.

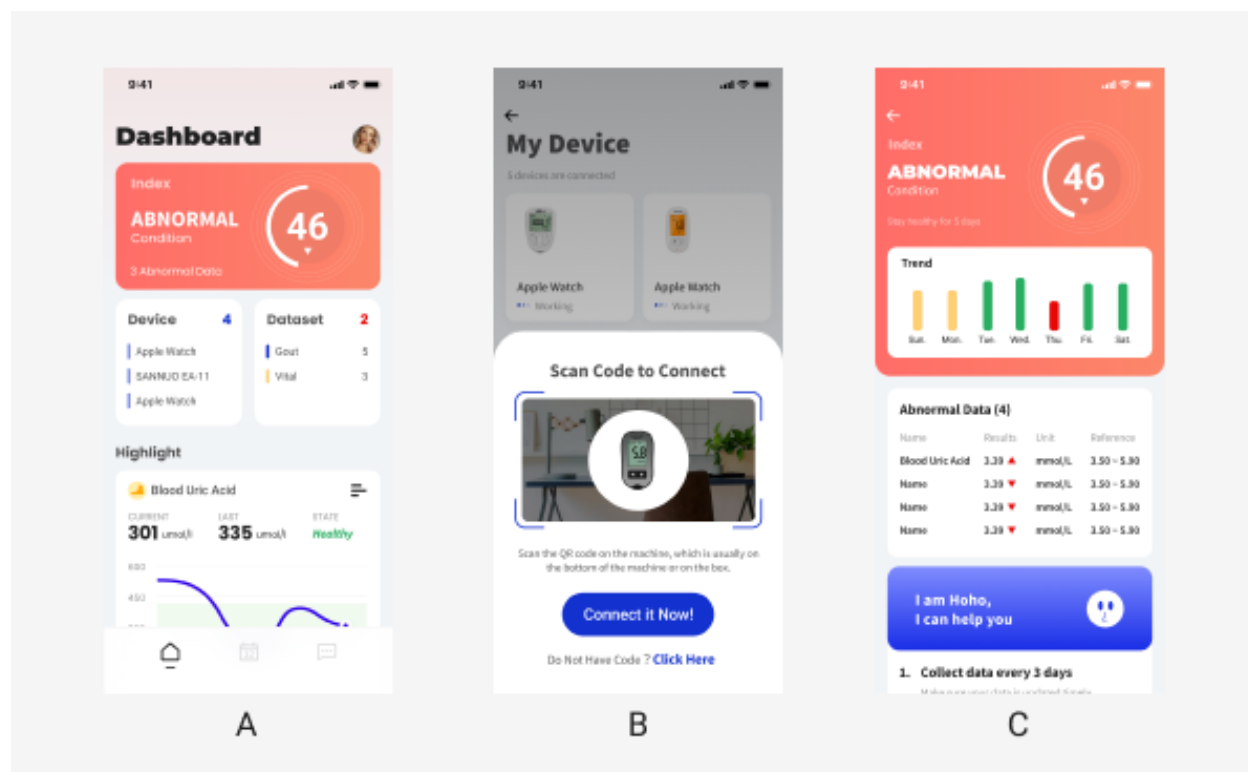


Figure 4

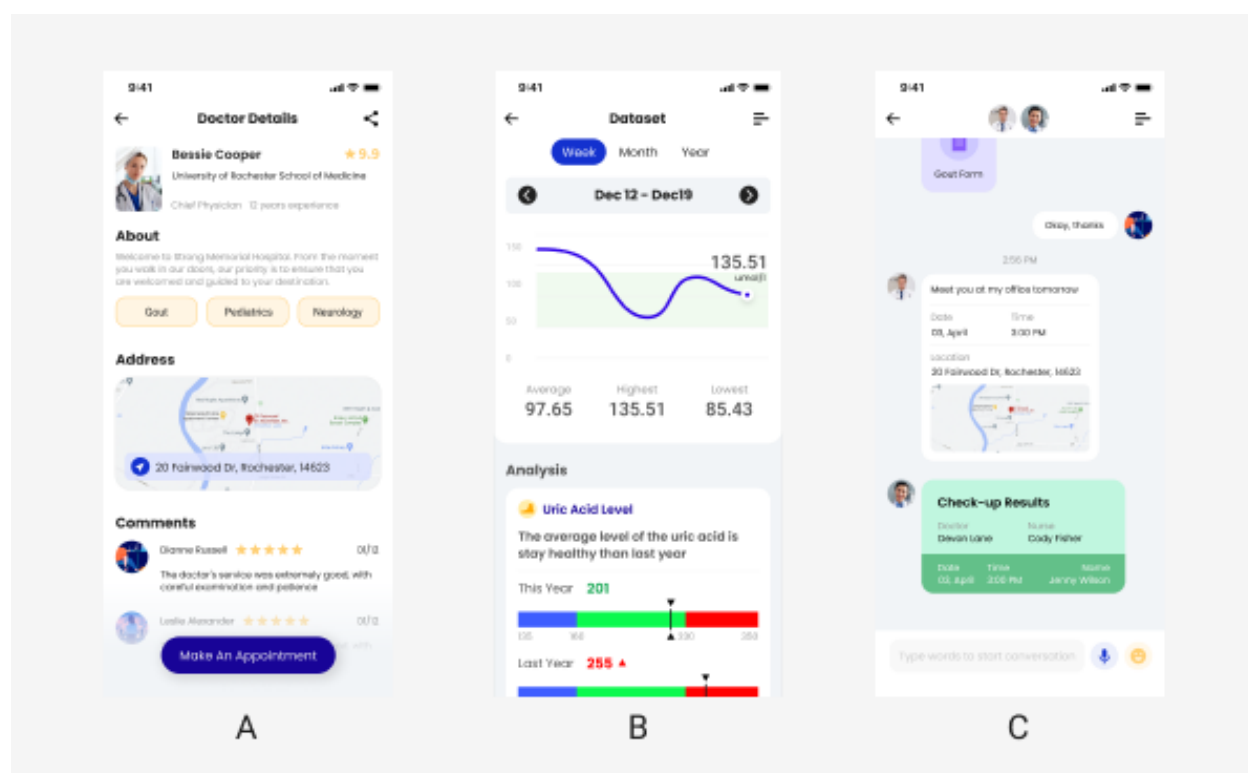


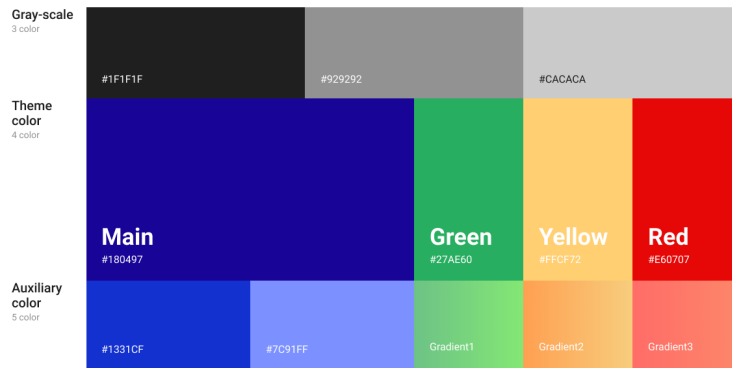
Figure 5

# Design System

## Phase 1: Color palette and typography

The color board specially designed for Healthway uses blue as the main color. Also, to match the atmosphere, three colors of red, green, and yellow are designed to refer to the state of health. I choose Poppins as the font family.

### Color Palette



### Font Family

Display	Font Family
Title	Font Family
Subtitle	Font Family
Body large	Font Family
Body medium	Font Family   Font Family
Body small	Font Family   Font Family
Comment	Font Family

Figure 6

## Phase 2: Data visualization

In the visual visualization part, I designed rich data visualization charts, including bar graphs, line graphs, fan graphs, bullet graphs, and another common graphs.

### Data Visualization

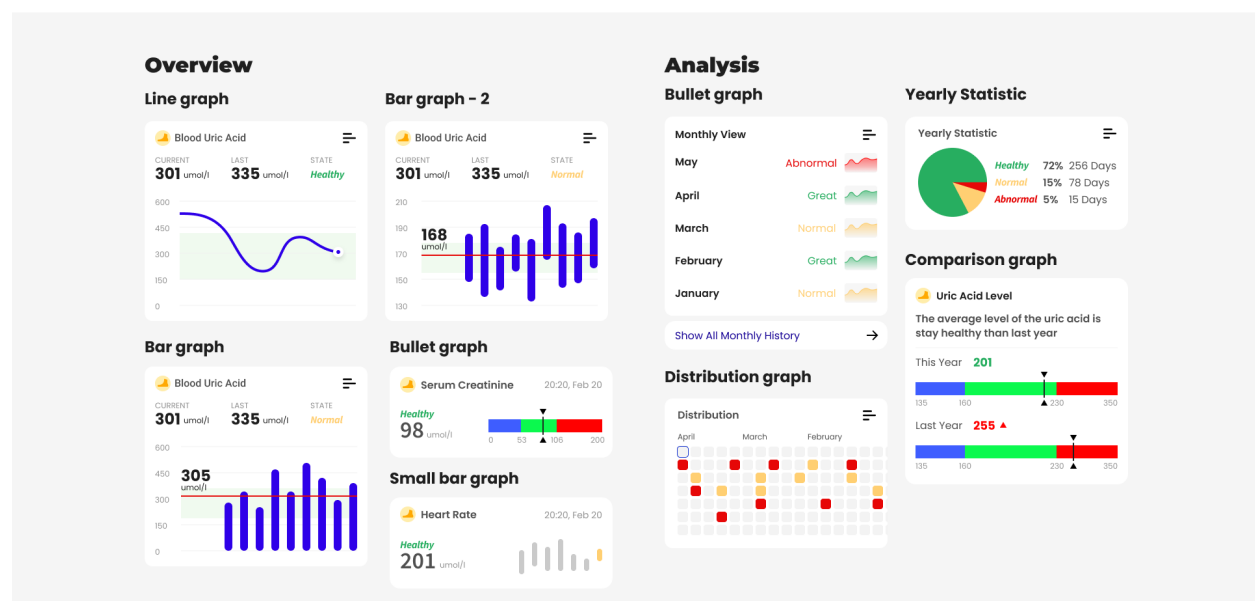


Figure 7

### Phase 3: Component

In the component part, I designed a general component library, including some commonly used interactive elements, such as navigation bar, button, pop-up window, card, chips, list, drawer, feedback, switch, time picker, etc.

### Phase 4: Branding

The inspiration of the Logo is derived from the design strategy, which is allowing the users to manage their health at home. The Logo is consists of two simplified houses. The negative space in the canvas composes the shape of the letter "H". The overall shape line is simple and clear, the color matching is bright.

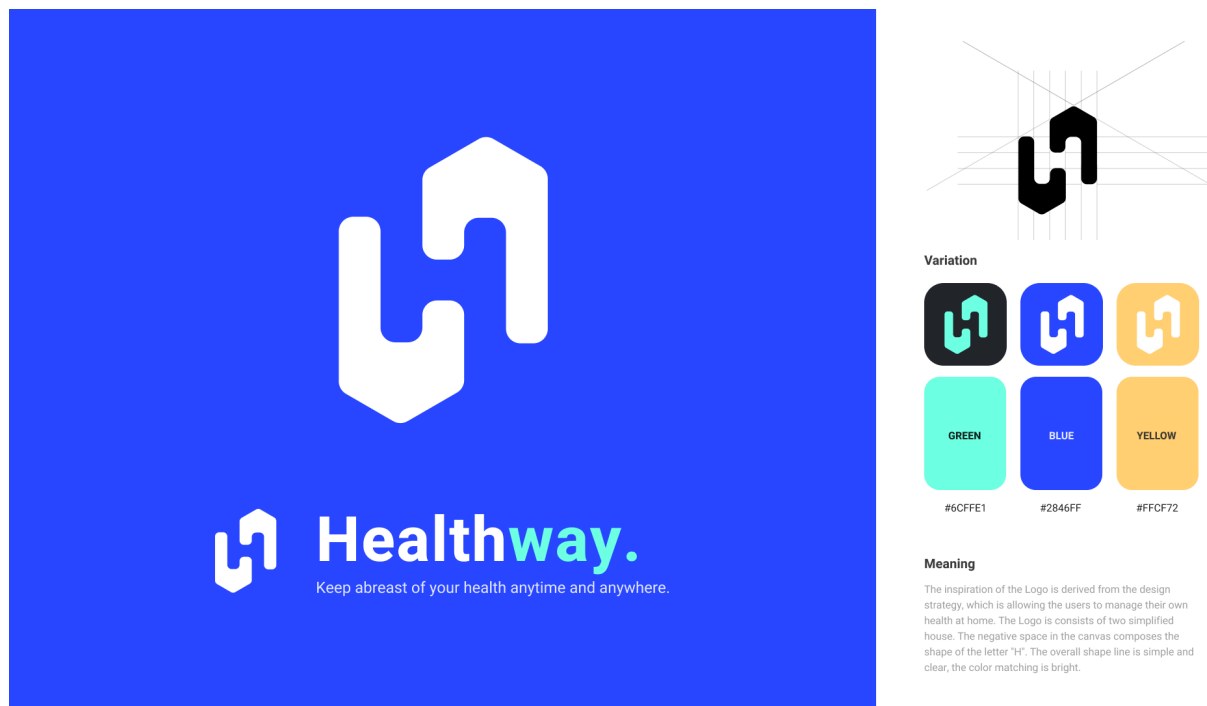


Figure 8

## Evaluation & Discussion

Design walk-through is one of the necessary processes for designers to verify their designs, and it is also the preliminary work for user testing. Detailed indicators need to be designed before walking inspection. Please refer to the next paragraph for details. These metrics are often the key factors that affect the user experience, and good design needs to satisfy these principles as much as possible. Based on these indicators, I carried out user tests. By conducting the tests, I could comprehensively review the project completion and quality, and predict the direction of the future iteration.

### Design walkthrough list

Part1: Information architecture

Accessible(overall); accessible(single page); affordance of main function and its entrance

## Part 2: User flow

The logic of the interaction for three scenarios; steps for main interaction;

## Part 3: Component

The usage for each design component; State changes of design component; Consistency for the component throughout the app.

## Part 4: Text

Understandable; Consistency of the same action in different screen

## Part 5s: Feedback

Loading state; a reminder of incorrect operation; tips for advanced interaction; second confirmation

## Iteration plan

In the phase of the user test, I found some patients with gout disease to test. Start with a brief introduction to HealthWay's product features. Then I assign tasks for them, which is based on the three user scenarios lists before.

Scenario 1: Connect IoT devices and view the data; Scenario 2: Receive timely health reminders and schedule a doctor; Scenario 3: Quickly get assistance from doctors

Through the test, I found four prominent problems after analyzing their comments and feedback. The four problems are listed below:

1. Card status that fails to complete data monitoring in time
2. Readability of some data cards to be optimized
3. Consistency of button and label components
4. The privacy notice should be reflected on the screen

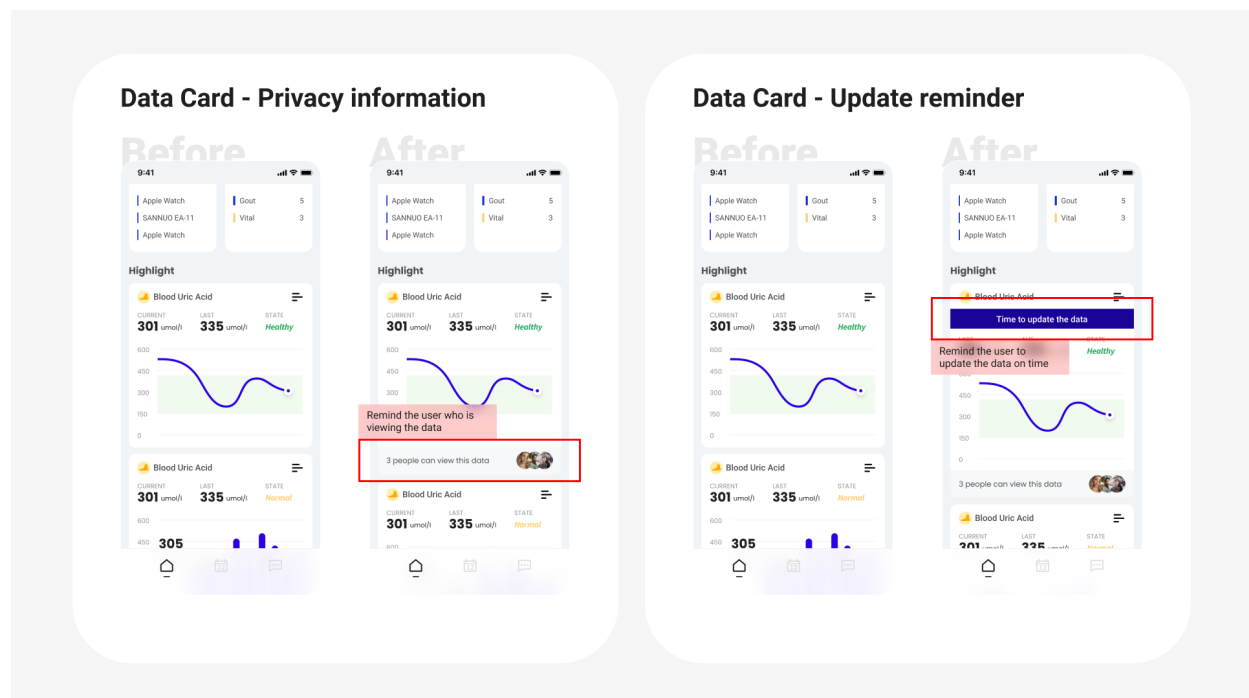


Figure 9



## Conclusions

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Through this project, I participated in the complete process of product design and implementation, including research, product design, interaction design, UI design, and other parts. Through this process, I have formed my understanding of the complete product design method. In the part of product design, I have the deepest feeling. From the discovery of opportunity points to the demonstration of the initial idea, it seems very simple. However, there are still many places that are worth deliberating on only through some data and the results obtained by my prediction.

In the early stage of launching Healthway, although I have conducted a lot of secondary research and interviewed experts and scholars, my knowledge of the medical industry is still weak, and I still need to do a lot of research and analysis if I want to build a perfect medical information platform. For the prospect of this project, it is very necessary to carry out a lot of research in the industry. In the future, I think it is more necessary to stand in the perspective of business to think about the significance of the product for the market and users.

For the final work, Healthway solves three initial challenges. (1) For the first problem which is difficult and inconvenient for patients to collect health data, the IoT device management module helps the users collect all of the relative data. (2) On the home page, there is a data dashboard for users to browse all information timely. The feature solve the second problem of the information lag. (3) The last problem is the tedious appointment process for patient to meet their doctor. Healthway provides appointment system, in order to facilitates the communication between patients and doctors. It also ensures that the service can be extended offline, making it seamless.

When I review the whole project, the degree of the delicacy of it is still not great enough. The simple one-round iterative process is not sufficient, and there are still a large number of experience problems that need to be continuously optimized and improved. Although there are some disadvantages, when I reviewing the results of the whole project, I still feel very gratified. The most significant thing is that the initial ideas are presented well through the Healthway. Some of the target users can build an understanding of the design solution and start to envision the positive role that health data can play in the treatment of disease.

If there is a second-round iteration in the future, I hope to focus on the data visualization part. I will pay more attention to how does a patient play around with the data. I will think about how to make data more friendly and attractive for patients to view over and over again.

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